STRUCTURAL AND GROUND PATTERN ANALYSIS OF MISSOURI AND THE OZARK DOME USING LANDSAT-2 SATELLITE IMAGERY

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INTRODUCTION

Visual analysis and evaluation of the imagery have been completed. The preliminary, composite lineament- and circular-features-map of Missouri, submitted with the Second Progress Report, has been finalized through imagery analysis and incorporation of known geologic data obtained from field investigations and subsurface information. Four lineament maps have been prepared by separating NE-, NW-, and N-S (E-W) lineaments (Figs. 1 through 3), and showing all lineaments together (Fig. 4). This approach facilitates analysis of individual lineaments and their relationship to each other. A fifth map, not included with this report, shows circular features only.

The final maps have been drafted on a 1 : 1,000,000 scale base map of Missouri. Copies of these maps are being distributed among geologists of the Geological Survey, Missouri Department of Natural Resources, so that they may be able to cross-check and correlate imagery features with geologic features in their specific mapping areas.

Selection of imagery features which need detailed ground-truth analysis is in progress. Ground-truth investigations will be carried out by other members of the research team during the coming months. These investigations are necessary for a better evaluation of the imagery features and of their role in controlling rock-type distribution, karst features, geologic structures, and mineral and water resources in the State.

Figs. 1 through 4 have been used in an invited talk entitled "Mineral-Resource Potential of Precambrian Basement Rocks in Missouri" by Geza and Eva B. Kisvarsanyi, which was presented on April 23, 1976, at the Symposium

on Mining and Utilization of Missouri's Non-Renewable Resources (Missouri Academy of Science Annual Sessions in Rolla, Missouri). We have emphasized the importance of satellite imagery and remote-sensing technology in mineral exploration. Abstracts of this talk are attached; the full paper will be printed later this year in the Transactions of the Missouri Academy of Science.

NE-TRENDING LINEAMENTS

Sixteen NE-trending major structural lineaments have been identified from the imagery (Fig. 1). They are located mostly to the south of the Missouri River. The reason for this is believed to be two-fold: 1) in the northern part of the State glacial drift cover effectively obscures many of the basement and Paleozoic structures, and 2) the Precambrian basement dips below 1,500 ft depth and reaches 3,500 ft depths below the surface in the extreme northwestern part of the State. The thick sedimentary cover prevented the appearance of structurally controlled lineaments on the imagery.

Most of the lineaments cross the entire State and extend into adjoining states with lengths in excess of 200 miles. They have been followed on the imagery into Arkansas, Kansas, and Oklahoma.

The lineaments are sub-parallel to each other or intersect each other at acute angles. Lineaments in the extreme southeastern part of the State may have a role in the New Madrid area seismicity. Many of the NE-trending lineaments cross the exposed and shallow Precambrian basement area centered around the St. Francois Mountains, and exerted a significant control over igneous activity and mineralization in the Precambrian rocks.

In the central part of the southern half of the State mega-lineaments cross the entire width of the State from the Missouri-Kansas-Oklahoma border to the St. Louis area. These lineaments cross the formerly very productive Tri-State mining district, and in part follow the course of the Missouri River.

In the southwestern part of the State three smaller lineaments intersect the major lineaments at an acute angle. They could not be traced toward the central and northern half of the State. There are indications that smaller lineaments are parallel with these. It will be important that these intersecting lineaments be investigated in the ground-truth studies. Their significance is especially enhanced by the fact that they cross a formerly active mining area and possibly influence water quality in this region.

NW-TRENDING LINEAMENTS

Thirteen major NW-trending lineaments have been identified in the State (Fig. 2). They are also concentrated in the southern half of the State, however, 5 mega-lineaments have been traced into northern Missouri across the Missouri River. Four of these extend to the northern border of the State.

The NW-trending lineaments are parallel to sub-parallel to each other; two of them intersect other lineaments at acute angles. The largest lineaments are regional in extent and are probably more than 300 miles long. The distribution and frequency of the lineaments are remarkable. The highest density of NW-trending lineaments is observed in southeast Missouri where the Precambrian basement rocks are exposed or are relatively close to the surface. The lineaments control significant geologic features in the State, and in part follow or control the course of the Missouri River. One of the mega-lineaments

intersects the New Madrid earthquake zone and extends as much as 200 miles to the northwest.

N-S-(E-W)-TRENDING LINEAMENTS

Six major NNE-N--SSW-S-trending lineaments have been identified on the imagery. They are relatively infrequent in comparison to the diagonal lineaments and are mostly in the southern half of the State. The eastern-most N-S-trending lineament (Fig. 3) cuts across the St. Francois Mountains (Roselle lineament). The lineament sub-parallel to it on the west cuts across the New Lead Belt or Viburnum Trend mining district. Other N-S lineaments are located to the west and in the northern part of the State.

Three major and several smaller E-W-trending lineaments have been identified on the imagery. In the east-central part of the State two of these cut across the St. Louis Metropolitan area. Structurally the most significant lineament among the E-W-trending ones is the 38th parallel fracture zone.

DISTRIBUTION AND SIZE OF LINEAMENTS

As it was previously reported, the organization and pattern of lineaments identified from LANDSAT imagery of Missouri is remarkably regular and repetitive. The consistency and regularity of lineaments can be especially well seen on the maps shown in Figs. 1 through 3. On the composite lineament map (Fig. 4) all the major lineaments are plotted. Study of these lineaments has contributed significantly to a better understanding of the regional structure of the State.

The relationship of lineaments to known structural features of the State is significant. We reported earlier that some relationship between imagery features, magnetic anomalies, and mineral deposits exists. Fig. 5. illustrates the distribution of major magnetic anomalies in Missouri. When compared with Fig. 2., it can be seen that the string of magnetic highs extending northwestward from central Missouri corresponds closely with one of the NW-trending mega-lineaments.

Our study not only confirms the relationship between lineaments and structural features, but will be indispensable in future studies of hydrogeologic conditions, cave development, underground cavities and cavity systems, and the search for potential mineral resources. The study of seismic activity in the State will also benefit from knowledge of the distribution of structural lineaments. Heat flux of the crust and the overall behavior of the crust may be better understood in the light of lineament studies. It is significant, that some of the major structural lineaments of Missouri cross geotectonic boundaries without interruption; others are terminated at geotectonic boundaries.

Fig. 1.

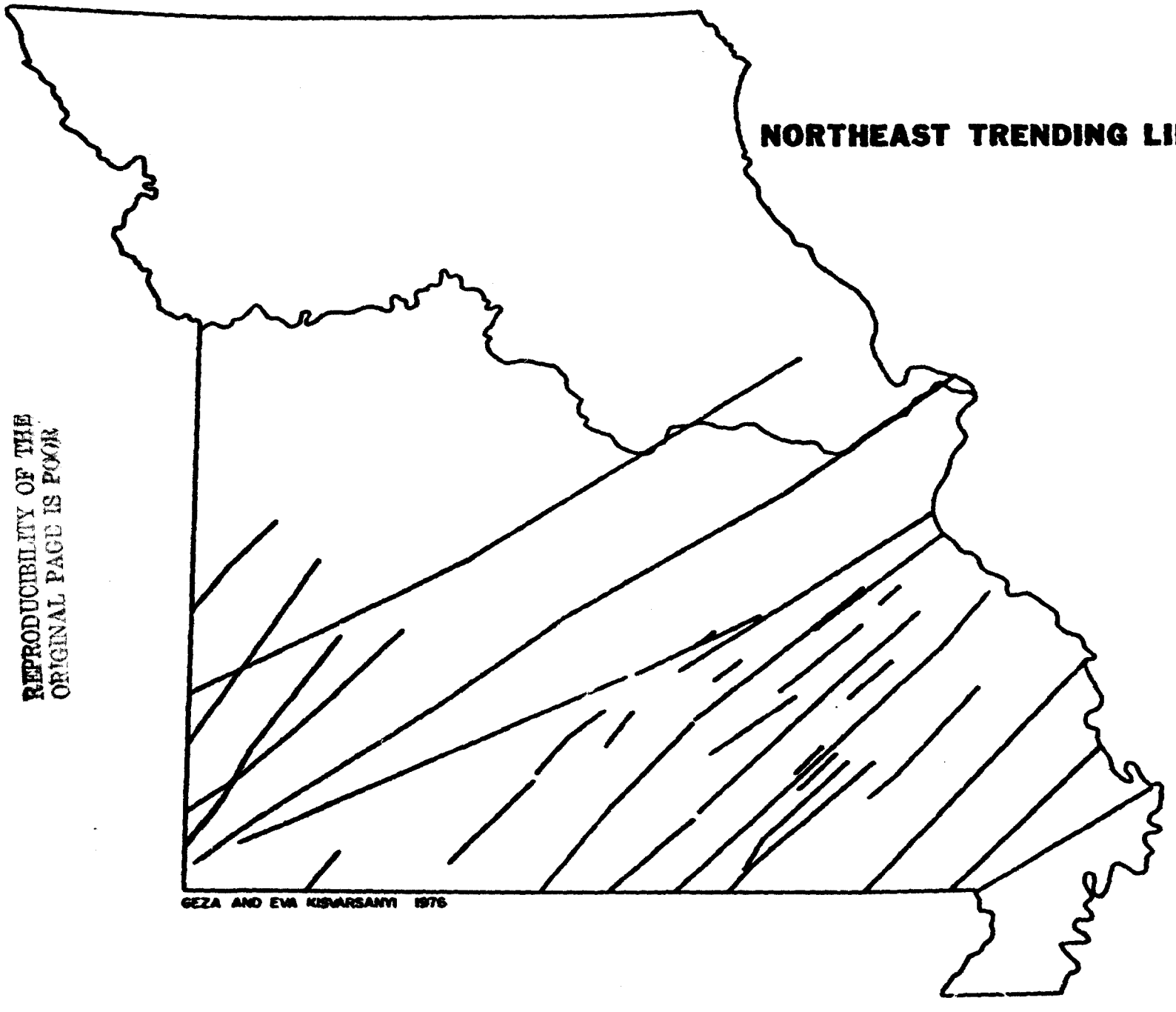


Fig. 2.

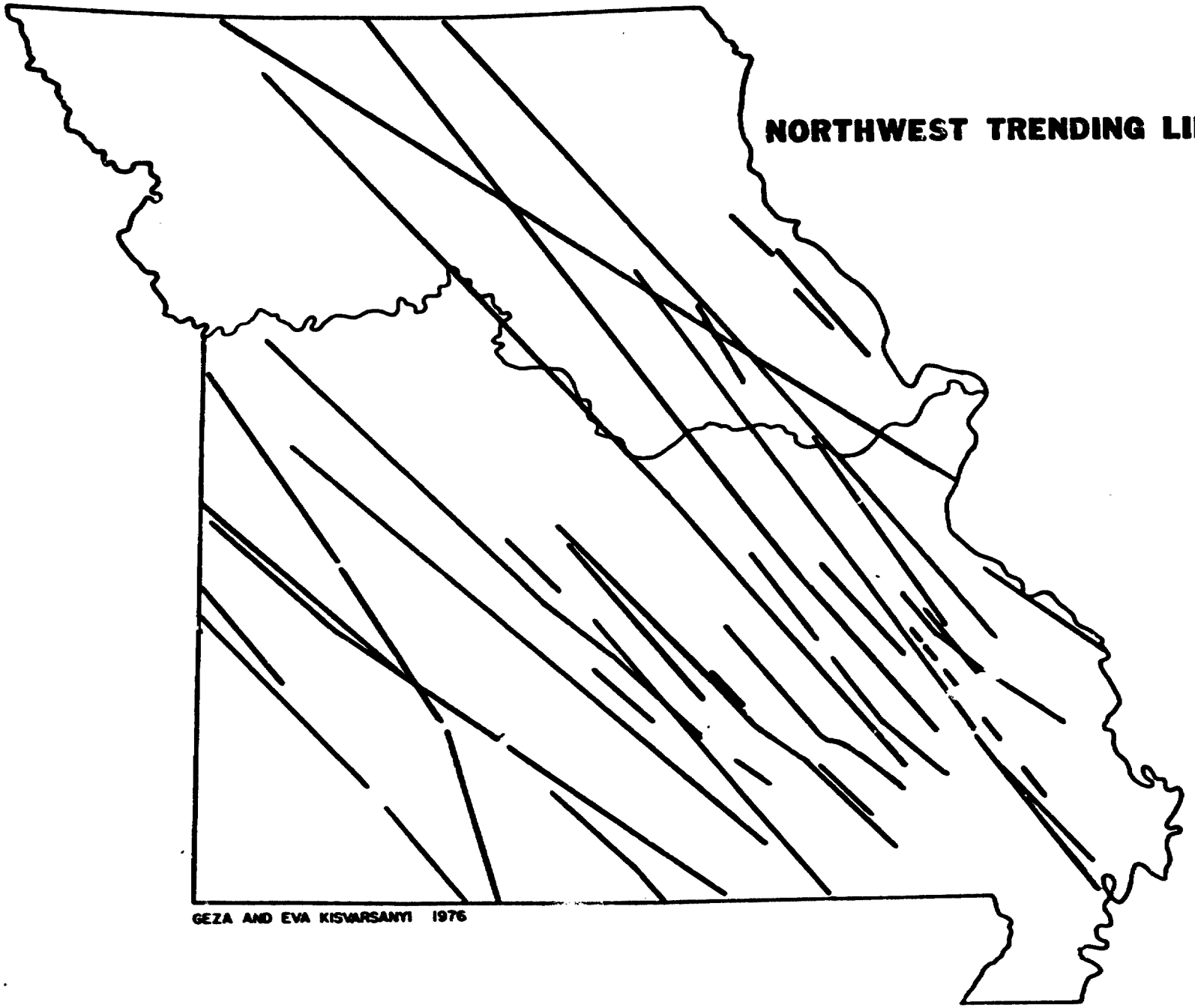

NORTHWEST TRENDING LINEAMENTS
GEZA AND EVA KISVARSANYI 1976

Fig. 3.

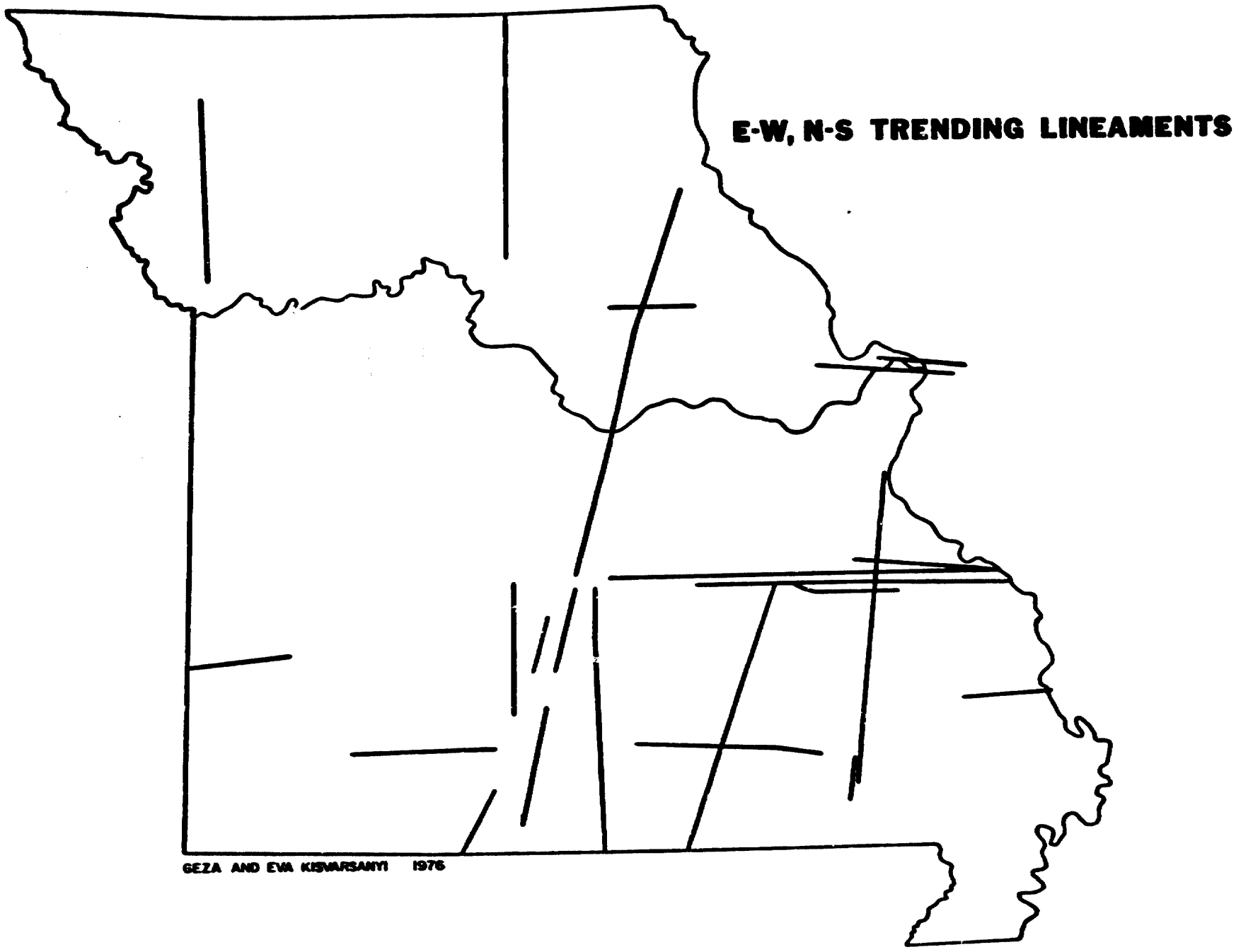
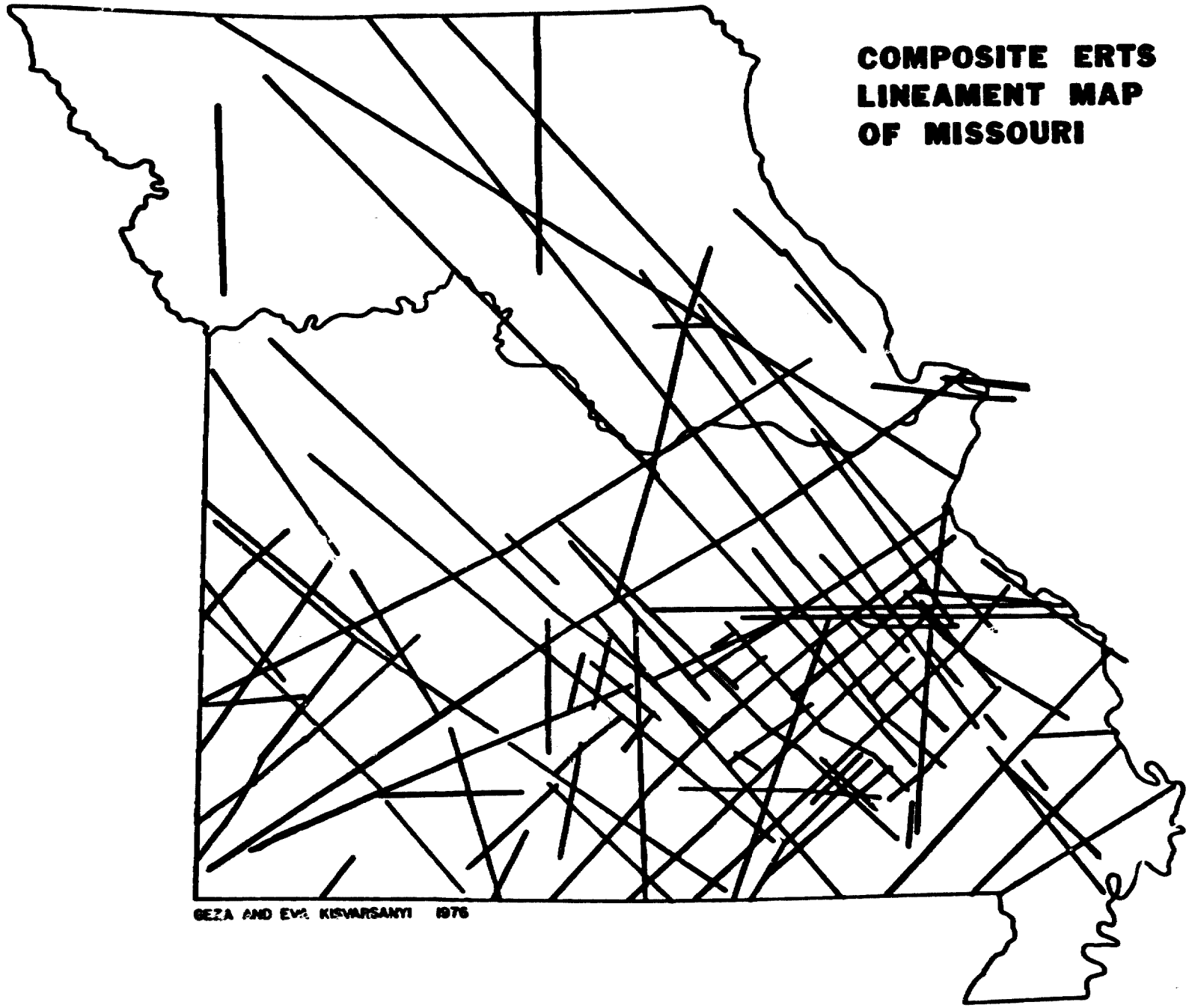
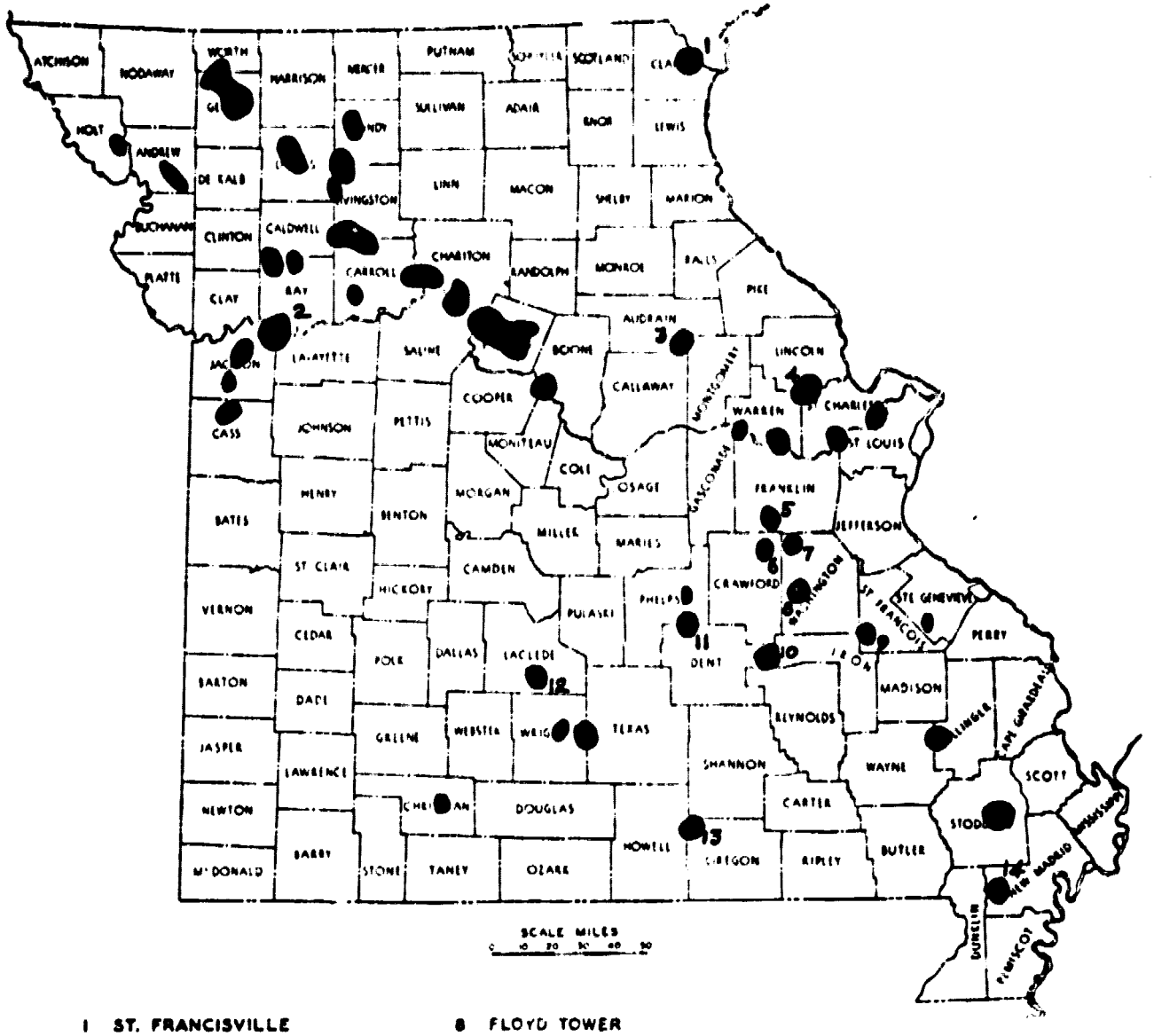


Fig. 4.


COMPOSITE ERTS
LINEAMENT MAP
OF MISSOURI
GEZA AND EVA KISVARSANYI 1975



1	ST. FRANCISVILLE	8	FLOYD TOWER
2	LEVASY	9	IRON MOUNTAIN
3	BENTON CITY	10	BOSS
4	WENTZVILLE	11	LAKE SPRING
5	KRATZ SPRING	12	ORLA
6	BOURBON	13	PEACE VALLEY
7	PEA RIDGE	14	MALDEN

MAJOR MAGNETIC ANOMALIES IN MISSOURI

MINERAL-RESOURCE POTENTIAL OF PRECAMBRIAN BASEMENT ROCKS IN MISSOURI. G. Kisvarsanyi (Geol. & Geophys., Univ. Mo., Rolla) and E. B. Kisvarsanyi (Mo. Geol. Survey, DNR, Rolla). Missouri's Precambrian basement rocks constitute a virtually untapped source of mineral wealth. The 1.5-b.y.-old St. Francois igneous terrane underlies approximately two-thirds of the State and has been the major source of iron production in Missouri for more than 150 years. Smaller economic concentrations of Mn, Cu, W, Ag, and Pb occur in the acidic rocks; high U and Th content has been found in certain granites. Intermediate and basic rocks are potential resources of Ti, Pt, Cr, Cu, Ni, Co, Pb, and Zn. Associated with these mineralizations are P, As, S, F, Ba, and rare earths. The mineral deposits are expected to be of high-temperature, magmatic, pegmatitic, hypothermal, contact metamorphic, and volcanic exhalative types. The potential for meso-epithermal veins of precious and base metals is small. Certain rocks are potential resources of industrial minerals (feldspar, fertilizers, construction stone). Another, possibly 1.7-b.y.-old, petrographically varied basement terrane is known only from limited drillhole data and is not a mineral producer. Its mineral potential is yet to be explored but cannot be dismissed.
A third and much smaller province of Paleozoic rocks is postulated to be present in the Precambrian basement where kimberlite-alnöite-carbonatite dikes and breccia pipes intersect the St. Francois terrane. It may contain enrichments of Nb, Ta, rare earths, and possibly diamond. Within a 14,000 sq km area in Southeast Missouri basement rocks are exposed or occur at depths of less than 500 m; elsewhere in the State they are covered by 500 to 1,500 m of sediments. The mineral potential of the Precambrian basement can be appraised only through development of exploration concepts based on the understanding of the tectogenesis and petrogenesis of these complex provinces, and by application of combined geologic and geophysical methods including structural analysis by satellite imagery. Strategic exploratory drilling is recommended to attract private industry. The only conversion route for hypothetical and speculative resources to become reserves is through basic research, geologic appraisal of analytical data, and exploration based on it.